

Fox River Implementation Plan

**A Plan to Improve Dissolved Oxygen and Reduce Nuisance Algae
in the Fox River**

The Fox River Study Group

December 17, 2015

Executive Summary

The Fox River Implementation Plan (FRIP) has been developed by the Fox River Study Group (FRSG) in partnership with Illinois Environmental Protection Agency (IEPA) and represents an innovative, stakeholder-driven approach to water quality improvement, as an alternative to the traditional Total Maximum Daily Load (TMDL) approach. The primary goal of the FRIP is to provide a road map to address water quality impairments for dissolved oxygen and excessive algal growth in the Fox River below the Stratton dam in McHenry, Illinois and, ultimately, achieve water quality standards. The FRIP is the product of more than a decade of extensive planning, data collection, scientific assessment and modeling undertaken by the FRSG with the support of the IEPA, the Illinois State Water Survey (ISWS), county and municipal governments, water reclamation districts, watershed and environmental groups.

The Fox River originates in Waukesha County, Wisconsin and flows through Illinois into the Illinois River at Ottawa, Illinois. The entire Fox River watershed encompasses 938 square miles in Wisconsin and 1720 square miles in Illinois (Figure ES-1). This FRIP focuses on the portion of the Fox River located between the Stratton Dam and the Illinois River. This spatial area is referred to as the “FRIP study area” and is approximately 98 miles long with a corresponding watershed of approximately 1,405 square miles.

The overarching goal of the FRIP is to define steps to be taken to attain the water quality standards for the Fox River, specifically with respect to aquatic life impairments associated with dissolved oxygen, total phosphorus and nuisance algae. As listed in the 2014 Illinois 303(d) list, these include:

- six segments of the Fox River within the FRIP study area listed as having dissolved oxygen as a cause of impairment with respect to the designated aquatic life use, totaling nearly 35 miles of the river
- nine segments with aquatic algae and total phosphorus as a cause of impairment with respect to the designated aquatic life use, totaling more than 65 miles of the river

The intent is to eliminate all water quality impairment listings associated with dissolved oxygen, total phosphorus and nuisance algae for the Fox River from the Illinois 303(d) list by causing the Fox to come into compliance with water quality standards. This outcome will meet the goal of the Clean Water Act, “to restore and maintain the chemical, physical, and biological integrity” of the Fox River with respect to dissolved oxygen, total phosphorus and nuisance algae.

By agreement between the IEPA and the FRSG, the FRIP will take the place of a traditional TMDL for dissolved oxygen and nuisance algae in the Fox River. No written agreement has been implemented between the IEPA and the FRSG regarding the FRIP, but the IEPA has worked closely with the FRSG in developing the FRIP since 2001. Because the IEPA’s authority to implement and enforce the Clean Water Act comes from the federal government, the FRIP will need to be approved by the U.S. EPA before it officially replaces the TMDL process. The need for a TMDL will be revisited by IEPA after implementation of the FRIP, by evaluating whether the listed reaches are still impaired.

With more than 1,200 square miles of upstream watershed, a portion of the annual phosphorus load to the FRIP study area comes from upstream. Within the FRIP study area there are 13 major municipal wastewater dischargers (major dischargers are facilities which discharge wastewater at levels greater than one million gallons per day) to the Fox River main stem, as well as nine major municipal wastewater dischargers on tributaries, all of which discharge phosphorus to the river in their effluent. Tributaries also

carry phosphorus loads from agricultural areas and urban stormwater (MS4s) to the Fox River. These sources contribute a total phosphorus load of approximately 1.29 million pounds per year to the Fox River downstream of Stratton Dam. The distribution of annual average load of phosphorus among these sources is shown graphically in Figure ES-2.



Figure ES-1: Fox River Watershed, Showing the FRIP Study Area

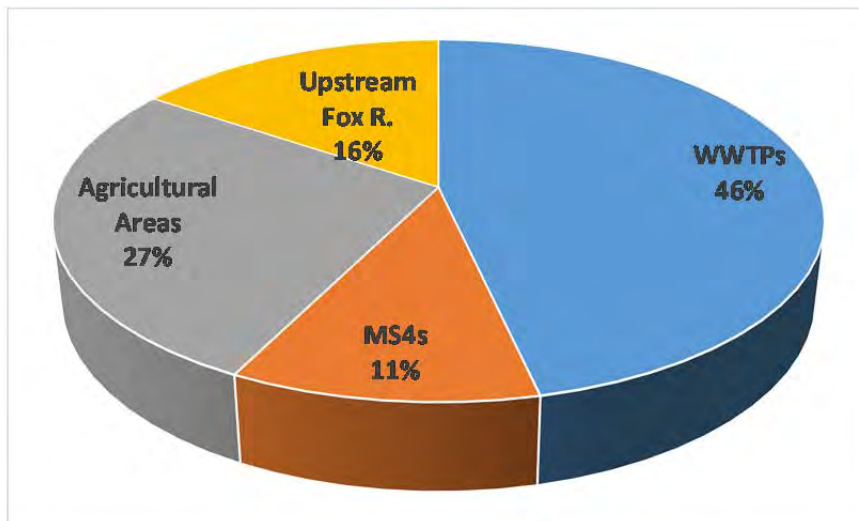


Figure ES-2: Distribution of Annual Average TP Load to the Fox River within the FRIP Study Area by Source – Current Conditions (1,291,000 lbs/yr).

Between the Stratton Dam, which forms the upstream boundary of the FRIP study area and the Dayton Dam, which is its downstream boundary, there are 11 dams on the Fox River which significantly alter the river and contribute to dissolved oxygen and algae growth conditions.

The main actions considered in the FRIP to improve dissolved oxygen and reduce nuisance algae are:

- Reduction of phosphorus loading from upstream
- Reduction of phosphorus loading from wastewater treatment plants (WWTPs)
- Reduction of phosphorus loading from non-point sources (agricultural areas and urban areas (MS4s))
- Dam removal

To evaluate the potential effects of these actions, the Illinois State Water Survey (ISWS) developed a calibrated QUAL2K water quality model application for the Fox River (Bartosova, 2013). This model was used to simulate future Fox River water quality in response to management actions considered in this FRIP. The ISWS originally calibrated the QUAL2K model using data from an intensive sampling event conducted at 13 locations on the Fox River during low flow conditions in June 2012. In an independent review of the ISWS QUAL2k model conducted by LimnoTech, two issues were identified with the model framework that would limit its utility to evaluate future management actions:

1. The model code was not predicting sediment oxygen demand properly, and
2. The model framework was not well-suited for assessing the water quality impact of non-point source load reductions.

LimnoTech was subsequently tasked by the FRSG to change the QUAL2K model code to correct the above issues and then change model inputs as necessary to provide recalibration to observed water quality data. The recalibrated model matches the calibration data well for total phosphorus, algae (phytoplankton) and ammonia, but as with the original calibration by ISWS, minimum dissolved oxygen (DO) is over-predicted

at several locations, indicating a limitation of the model for evaluating impacts of load reduction on minimum DO.

The Fox River QUAL2K water quality model is the primary tool used in development of the FRIP to evaluate alternatives for water quality improvement, but because of the important limitations related to the model's dissolved oxygen calibration, the following notes should be heeded when reviewing the model results presented in the FRIP:

- Model calibration results for DO show that the model significantly over-predicts minimum DO and under-predicts maximum DO in many locations and this model limitation should be taken into account when reviewing all model results for dissolved oxygen.
- The model results show good agreement with calibration data for total phosphorus and algae in the water column. Therefore, there is greater confidence in the model for these constituents.

As a consequence of the first bullet above, the actual minimum DO for a given load reduction scenario presented in this section may be significantly lower than the minimum DO predicted by the model.

In developing the FRIP, a range of scenarios involving different combinations of phosphorus load reductions and dam removals were simulated using the QUAL2K model; many of these are presented in Section 5 of this report. However, because of the limitations of the QUAL2K model, no combination of actions can be identified at this time to meet dissolved oxygen water quality standards in the Fox River at all locations and at all times of the year under critical low flow conditions. (IEPA requires water quality standards by met at all flows at and above the average minimum seven day low flow which occurs once in ten years, abbreviated as 7Q10 flows.)

Because of the model uncertainty, implementation of the FRIP will require an adaptive approach of implementing actions, evaluating the effectiveness of those actions and then planning additional actions deemed most appropriate.

In the near-term, the following actions are planned for implementation:

- Effluent limits on municipal WWTPS – NPDES permits have been, or soon will be, issued for all major (>1.0 MGD) municipal WWTPs in the FRIP study area, containing TP limits of 1.0 mg/l (annual average).
- Upstream TMDL – The IEPA is developing a phosphorus TMDL for the Chain O'Lakes on the Fox River upstream of the FRIP study area. When fully implemented, it is expected that water quality in the Chain O'Lakes will meet the state's water quality standard for total phosphorus (0.05 mg/l) for lakes. Ongoing data collection will be used to show progress in meeting this goal.
- Dam removal –The Forest Preserve District of Kane County and the Village of North Aurora have intergovernmental agreements (IGAs) in place with the Illinois Department of Natural Resources (IDNR) to study and plan the removal of the Carpentersville and North Aurora dams, respectively. These dams could potentially be removed within the next five years, but until the ongoing studies are completed, no schedule can be specified.
- Non-point source (NPS) controls – Each MS4 jurisdiction will track the phosphorus load reduction anticipated from projects they implement to reduce pollution from stormwater runoff and submit a report to the FRSG annually.

The actions described above are expected to reduce total phosphorus loading to the Fox River by an estimated 463,400 lbs. per year on average. In addition to improving water quality in the Fox River, these load reductions will have water quality benefits on downstream water bodies and will reduce the overall export of nutrients from the State of Illinois to the Mississippi River and the Gulf of Mexico. The Illinois

Nutrient Loss Reduction Strategy calls for an overall nutrient reduction of 45% statewide and the actions outlined here will result in approximately a 35% reduction in phosphorus loads to the Fox River.

The near-term actions described above were simulated using the Fox River QUAL2K model to observe the potential effects of the actions on water quality. The results are depicted in Figures ES-3 through ES-5 for the month of July and in Figures ES-6 through ES-8 for August. These two months have been identified as the periods of the year when violations of the dissolved oxygen standard are most pronounced. Current conditions under critical 7Q10 low flows are shown in red; near-term actions are shown in blue.

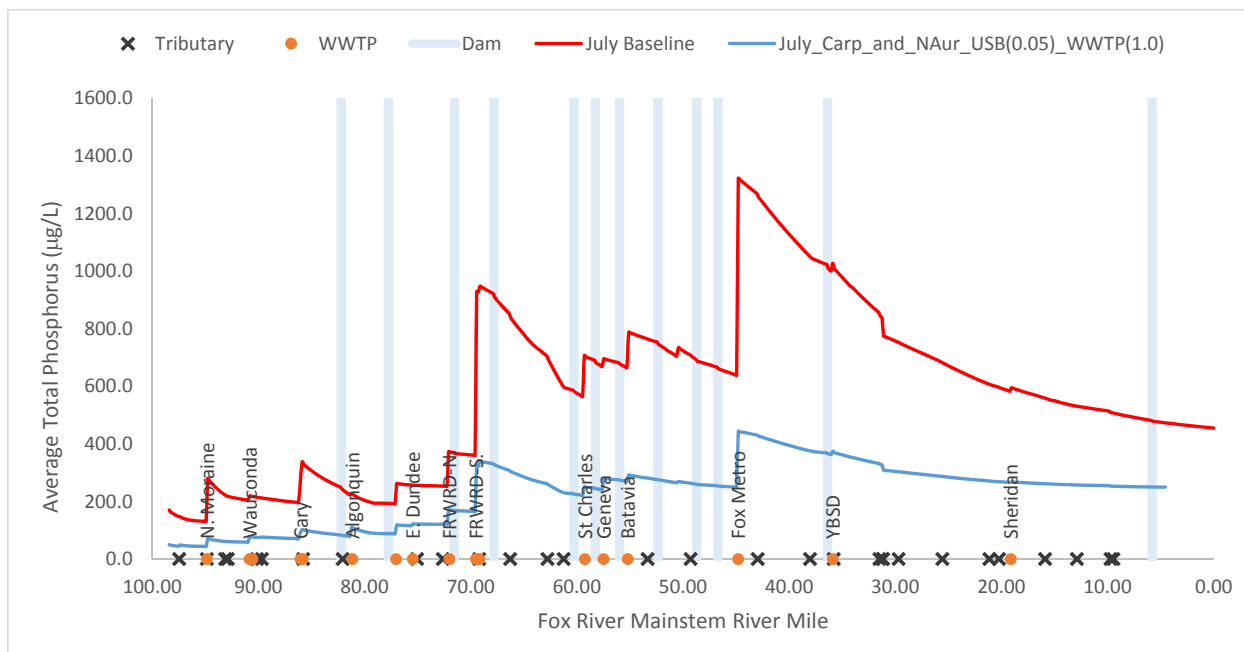


Figure ES-3: QUAL2K Total Phosphorus Results for Near-Term Actions – July.

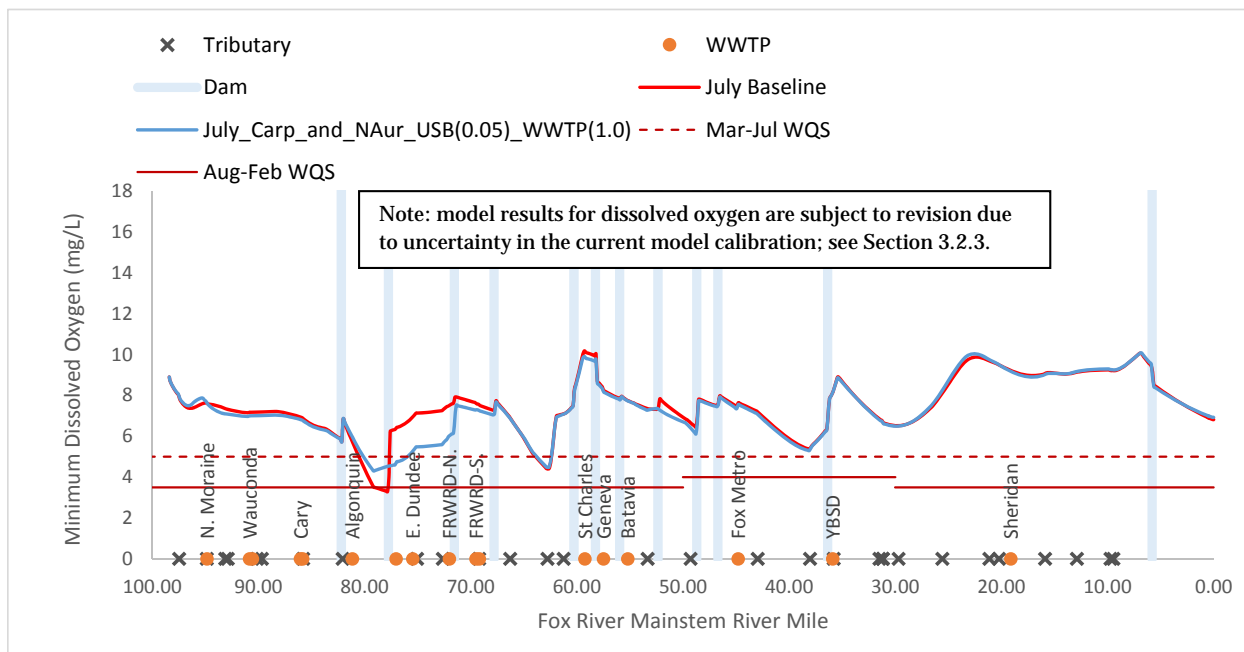


Figure ES-4: QUAL2K Minimum Dissolved Oxygen Results for Near-Term Actions – July.

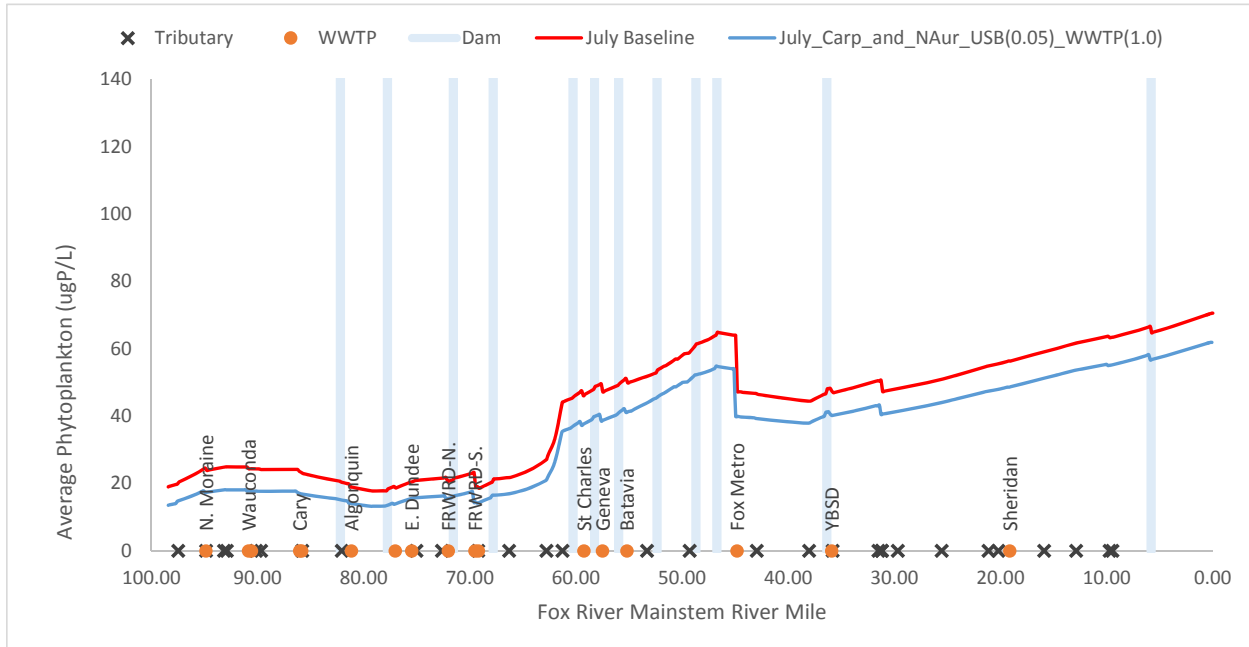


Figure ES-5: QUAL2K Average Phytoplankton Results for Near-Term Actions – July, Showing Decrease in Phytoplankton with Decreased Phosphorus Loading

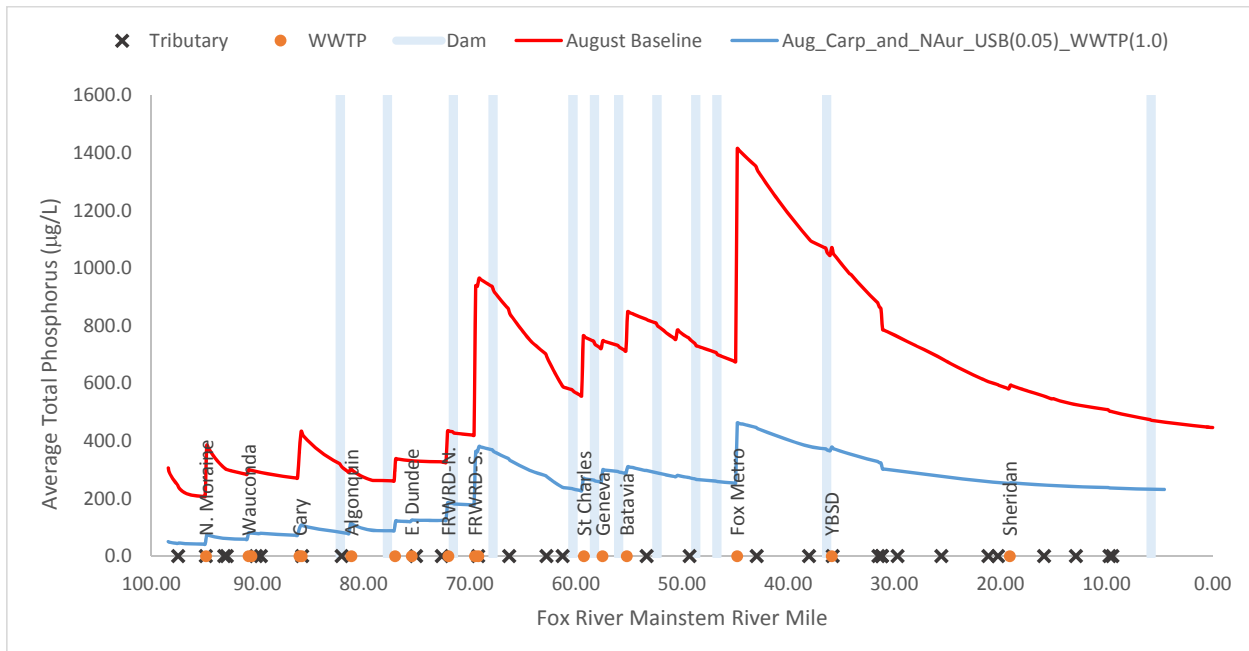


Figure ES-6 QUAL2K Total Phosphorus Results for Near-Term Actions – August.

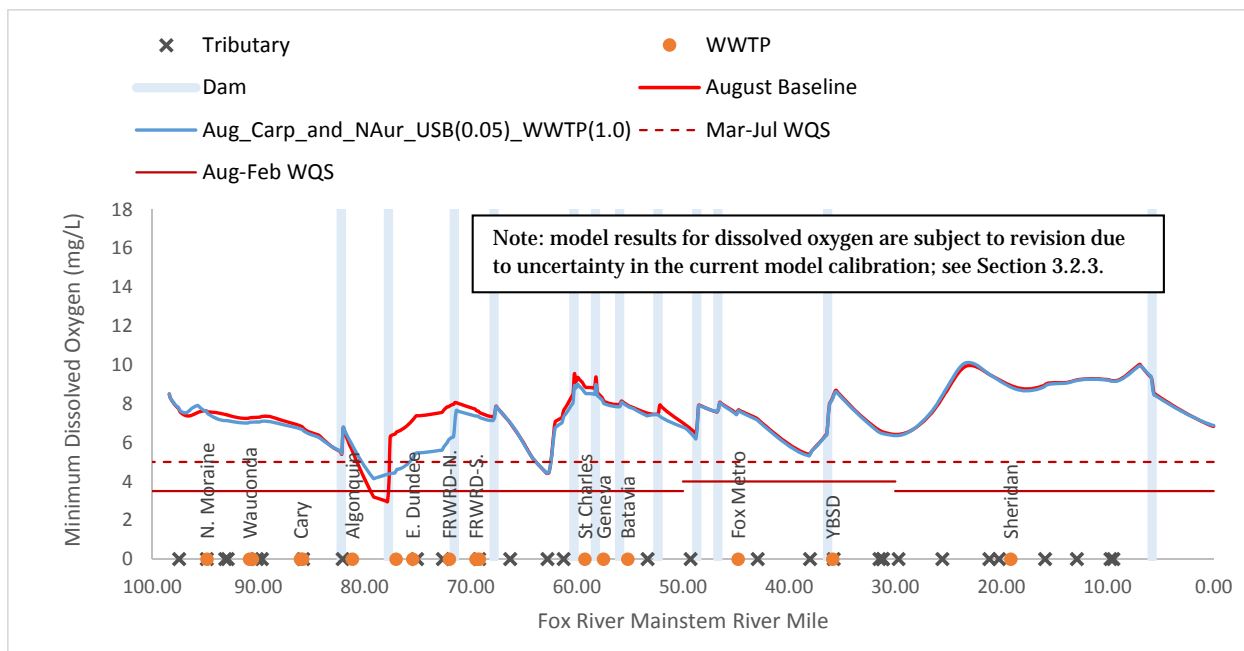


Figure ES-7: QUAL2K Minimum Dissolved Oxygen Results for Near-Term Actions – August.

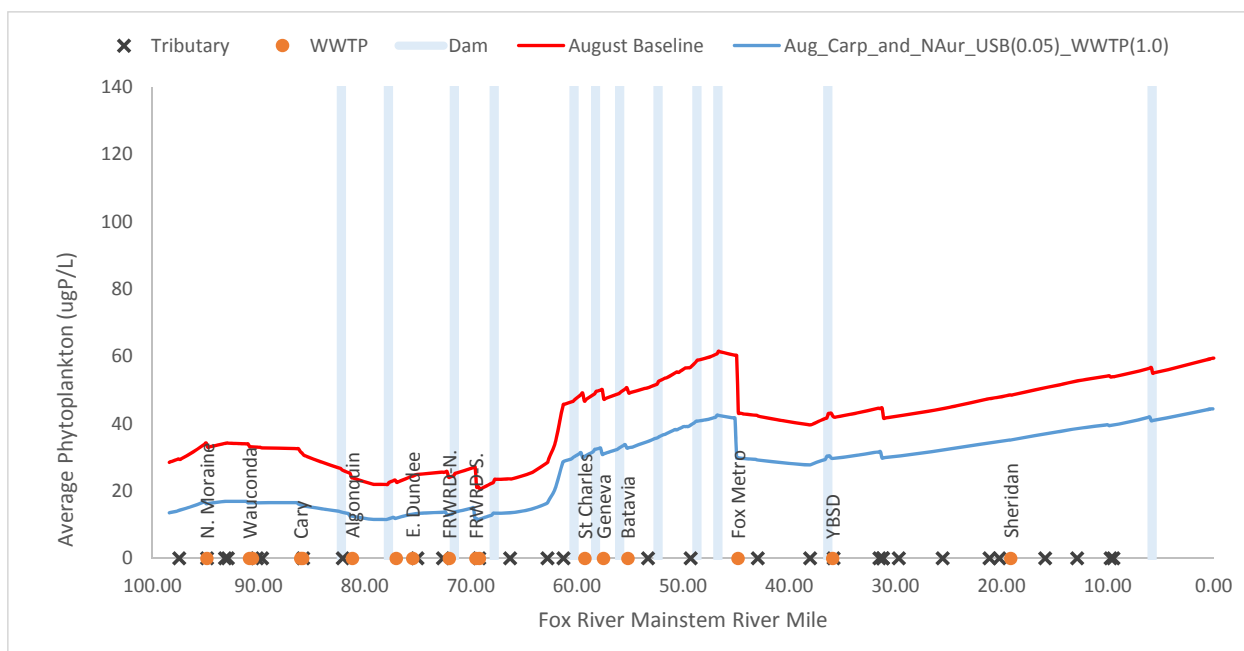


Figure ES-8: QUAL2K Average Phytoplankton Results for Near-Term Actions – August, Showing Decrease in Phytoplankton with Decreased Phosphorus Loading

Based on the model results presented above, the near-term actions described here should result in measurable reductions in total phosphorus concentrations in the river, as well as a significant reduction in algae during July and August under low flow conditions. However, although the actions are to be implemented in the next ten years, it is possible that water quality improvements may take longer to occur, especially those related to the implementation of the TMDL for the Chain O'Lakes upstream of the FRIP study area.

In addition to the actions described above, the FRSG will continue to work towards further water quality improvement and attainment of water quality standards by conducting the following activities:

- **Monitoring** – The FRSG will continue to be a clearinghouse for relevant water quality data collected by stakeholders and others. Members of the FRSG will submit effluent monitoring and water quality data they collect to the FRSG. The ISWS will continue to update the Fox River database with these new data. The FRSG will coordinate with the Illinois DNR and IEPA regarding data collection associated with the potential removal of dams on the Fox River, including water quality, biotic and physical data. In 2016, the FRSG will develop a strategy for future data collection and prepare written plan(s). The FRSG also plans to coordinate with IEPA and IDNR to discuss Intensive Basin sampling that is scheduled for 2017. Once plans are finalized, the FRSG will update the necessary Quality Assurance Project Plans (QAPPs) to insure data quality and usability.
- **Additional modeling** - Because of the limitations of the current Fox River QUAL2K water quality model in simulating DO in the river, it is understood that an improved modeling approach is needed. At a minimum, this would involve investigation and correction of the current model's limitations, but other alternatives are possible. Within the next year, the FRSG will solicit expert recommendations on model improvement and develop a plan for future modeling.
- **Tracking** – The FRSG will track actions taken by municipal WWTPs and MS4 jurisdictions and this information will be reported annually to IEPA. Major municipal WWTPs will report the status of their phosphorus treatment improvements to the FRSG annually and, as part of that report, will provide estimates of annual average phosphorus load reductions from completed actions. MS4 jurisdictions will be required to track and submit annual reports to the FRSG summarizing stormwater management actions that have been implemented, along with the estimated annual average phosphorus load reduction for each action and the total estimated annual load reduction.
- **Periodic review** – The FRSG will conduct a review of the FRIP every five years to determine the need for an update to the FRIP and, if needed, what that update should include. A summary of the review and the FRSG decision regarding the need for a FRIP update will be submitted in writing to the IEPA.
- **Reporting** - The FRSG will submit an annual letter report to the IEPA summarizing relevant new information. The annual report will be submitted by the end of March for each preceding calendar year.
- **Public engagement** – Development of the FRIP has been a stakeholder-driven process and its implementation will continue to rely on dissemination of information to the public. Public engagement activities to be continued by the FRSG will include web site maintenance and updates, monthly FRSG meetings and the annual Fox River Study Group meeting.